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Evaluation of a Habitat Capability Model for Nongame Birds in the Black Hills, South Dakota

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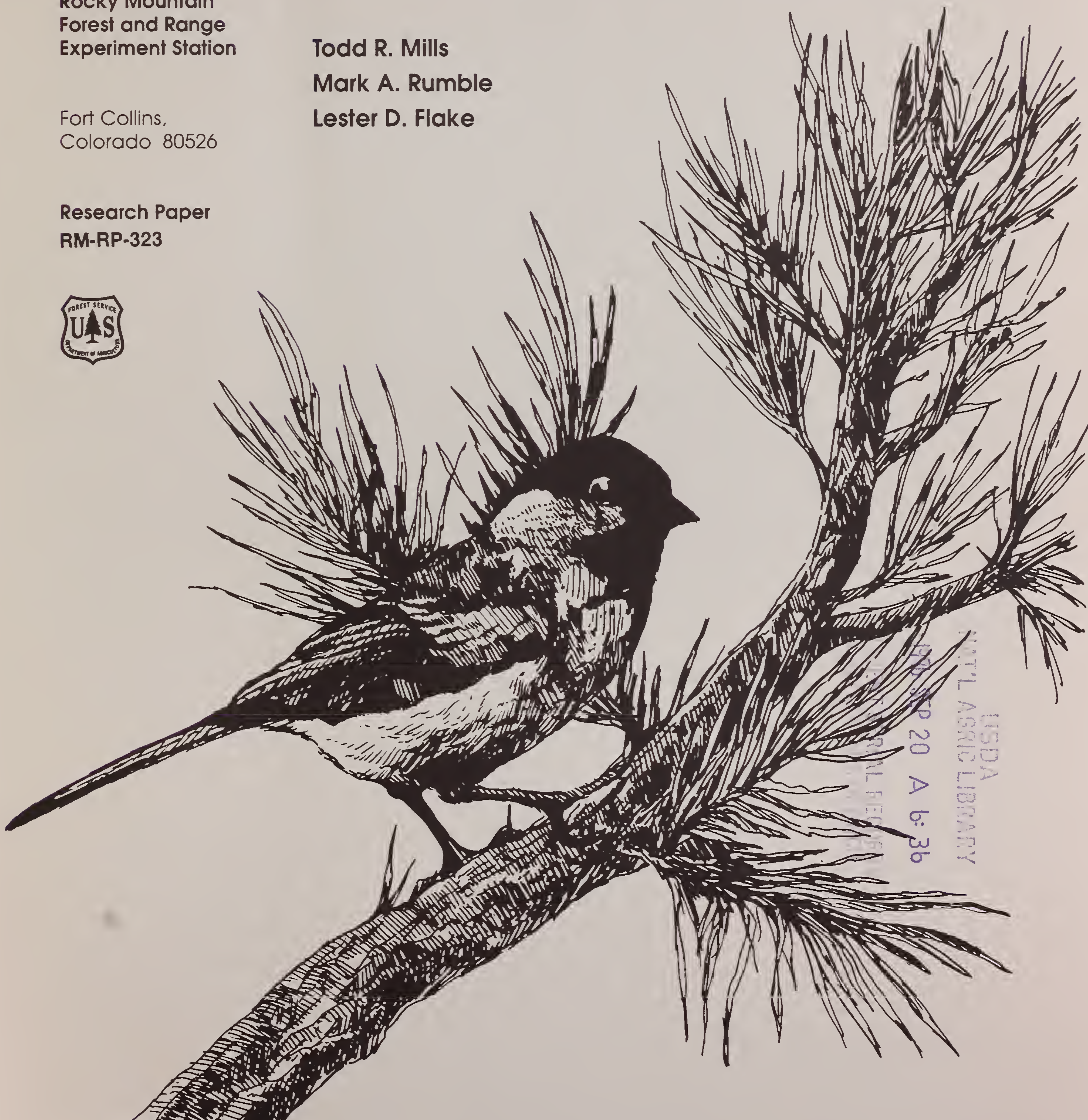

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Habitat models, used to predict consequences of land management decisions on wildlife, can have considerable economic effect on management decisions. The Black Hills National Forest uses such a habitat capability model (HABCAP), but its accuracy is largely unknown. We tested this model's predictive accuracy for nongame birds in 13 vegetative structural stages of ponderosa pine (*Pinus ponderosa*), aspen (*Populus tremuloides*)/birch (*Betula papyrifera*), and meadow habitats in the Black Hills, South Dakota from 1992 through 1994. We used data collected during the first two years to test HABCAP model coefficients for 11 species, and develop coefficients for 9 species not included in the existing model. We then made a different-time-and-location test of the revised model coefficients for all 20 species. Coefficients that differed from predicted use were revised. The final model provides managers with more accurate assessments of effects of alternative forest management practices on nongame birds.

Keywords: habitat models, bird abundance, nongame birds in forests, forest management, logging

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Evaluation of a Habitat Capability Model for Nongame Birds in the Black Hills, South Dakota

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MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

Birds are sensitive indicators of habitat conditions because of their distinctive breeding ranges and habitat requirements. Ten of the bird species discussed here are neotropical migrants, eight of which require forests for nesting. Bird species restricted to riparian habitats and montane forests in the western United States are particularly vulnerable to disturbance (Terborgh 1989) due to limited population sizes, travel corridors, range expansion of other species, and elevational gradients of habitat use (Finch 1989, 1991). Logging and the resulting changes to forest structure will influence abundance and composition of bird populations.

These habitat capability (HABCAP) model coefficients for 20 bird species in 13 structural stages should increase the capability of forest managers in the Black Hills to predict the consequences of management decisions on wildlife. Habitat capability for a species j is estimated as:

$$HABCAP_j = \sum_{i}^{n} C_{ss_{ij}} \times A_{ss_i}$$

the sum for n structural stages in the area of interest of the acreage in each of structural stage (A_{ssi}) times the coefficient for species j in structural stage i (C_{ssij}). Effects of a management prescription can be estimated by applying the model to the post-treatment projected composition of structural stages and evaluating the relative changes in habitat capability.

Multiyear evaluations increase the accuracy of habitat models (Block et al. 1994). Because some habitat changes are short term and others long term, these model coefficients should be monitored for applicability over time and revised as necessary. HABCAP models assume an equilibrium between populations and habitats; spatial and temporal variation are not accounted for in them.

BACKGROUND

Habitat selection, foraging behavior, and reproductive success of forest-dwelling birds are influenced by vegetation structure, diversity, and composition (Robinson and Holmes 1984, Anderson and Shugart 1974, MacArthur and MacArthur 1961). Logging in coniferous forests of western North America affects the distribution and abundance of birds by changing the structure and composition of vegetation (Szaro and Balda 1979b, Franzreb and Ohmart 1978). Logging benefits some species, but is detrimental to others (Bull et al. 1980). In a ponderosa pine forest of Arizona, Szaro and Balda (1979a) found that bird species diversity and richness were altered only by clearcuts, but removal of 1/6 of the foliage altered abundance and composition of bird communities.

Snags are frequently removed during logging (McComb et al. 1986, Mannan et al. 1980), thus affecting cavity-nesting birds. Abundance of cavity-nesting birds is greater in pine forests with snags than in similar logged forests where snags are cut (Balda 1975). Even if the cavity nest trees are undisturbed during logging, altering the surrounding habitat alters habitat suitability for some cavity-nesting birds (Lawrence 1967).

Habitat models for birds have been developed using vegetative successional stages (e.g., Holt 1974, Kendeigh 1945), life forms (e.g., Thomas et al. 1975), and microhabitat characteristics (e.g., Rotenberry and Wiens 1978). Habitat models provide a valuable tool to predict the effects of habitat changes on a variety of species. On public lands, managers must document the effects of management practices on environmental resources (National Environmental Policy Act 1969). Successional-stage and life-form approaches to modeling bird habitat relationships are frequently used by land managers because logging affects the size and condition class of forests by forest type (DeGraaf and Chadwick 1987). The Black

Hills National Forest uses a successional-stage habitat capability (HABCAP) model to assess the quality of vegetative cover types and life forms, and predict the effects of logging on wildlife species. At the outset of this research, the HABCAP model included 54 species, 34 of which are birds.

OBJECTIVES

Untested habitat models should not be relied upon (Laymon and Barrett 1984). Original coefficients depicting habitat capability for nongame birds in the HABCAP model were developed from literature reviews, and had not been tested in the Black Hills. Yet, land managers consider the HABCAP model outputs in decisions with both economic and long-term habitat ramifications.

The objectives of this study were: 1) test species-habitat associations of birds predicted by the existing HABCAP model for 13 structural stages in 4 vegetation types in the Black Hills, 2) revise the HABCAP model, including new coefficients for birds not in the existing model, and 3) then conduct a different-time-and-location test of our modifications to the HABCAP model. We use the terminology 'existing' HABCAP model for the model coefficients at the outset of our research, 'new' for coefficients for bird species added to the model, 'revised' for model coefficients resulting from our test of the 'existing' and 'new' model coefficients, and 'final' for HABCAP model coefficients developed from the different-time-and-location test of the 'revised' model.

METHODS

Study Area

This study was conducted on the Nemo, Pactola, and Spearfish Ranger Districts of the Black Hills National Forest, in the central Black Hills, South Dakota (fig. 1) from 1992 to 1994. The Black Hills are a unique range of mountains encompassing approximately 15,540 km^2 on the west-central border of South Dakota surrounded by prairie and shrub steppe ecosystems. Elevation ranges from 1450 m to 1770 m. Annual precipitation for the area is approximately 46 cm (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Climatological data annual summary, South Dakota 1992–1993, Asheville, NC).

Vegetation

Vegetation is predominately ponderosa pine. Climax vegetation in the central region of the Black Hills includes ponderosa pine/snowberry (*Symphoricarpos albus*) and ponderosa pine/kinnikinnick (*Arctostaphylos uva-ursi*) (Hoffman and Alexander 1987). Understory shrubs include: common juniper (*Juniperus communis*), serviceberry (*Amelanchier alnifolia*), ninebark (*Physocarpus monogynus*), common chokecherry (*Prunus virginiana*), currant (*Ribes* spp.), wood rose (*Rosa woodsii*), russet buffaloberry (*Shepherdia canadensis*), wild spirea (*Spiraea lucida*), raspberry (*Rubus idaeus*), and poison ivy (*Toxicodendron rydbergii*). Quaking aspen (*Populus tremuloides*) occurs in monotypic stands and in drainages with paper birch (*Betula papyrifera*).

Sampling Design

We identified 13 vegetative structural stages with adequate distribution to include in this study (table 1). Vegetative structural stages were determined hierarchically from dominant vegetation, diameter breast-height (DBH), and overstory cover (Buttery and Gillam 1983). Structural stages of forested stands are visualized as successional patterns following

Table 1. Ponderosa pine, aspen/birch, wet meadow, and dry meadow structural stages categorized by diameter breast-height (DBH) and overstory cover[1].

Vegetation type	DBH	Overstory cover	Acronymn
Ponderosa pine	<22.9 cm	0–40%	P3A
Ponderosa pine	<22.9 cm	41–70%	P3B
Ponderosa pine	<22.9 cm	71–100%	P3C
Ponderosa pine	>22.9 cm	0–40%	P4A
Ponderosa pine	>22.9 cm	41–70%	P4B
Ponderosa pine	>22.9 cm	71–100%	P4C
Ponderosa pine	>22.9 cm	71–100%	P5[2]
Aspen/birch	<2.5 cm	NA[3]	A2
Aspen/birch	<22.9 cm	0–40%	A3A
Aspen/birch	<22.9 cm	41–70%	A3B
Aspen/birch	<22.9 cm	71–100%	A3C
Wet Meadow	NA	NA	WM
Dry Meadow	NA	NA	DM

[1]Structural stage categories and acronymns taken from Buttery and Gillam 1983.
[2]P5 classification represents old-growth structural stage.
[3]NA indicates the category is not applicable.

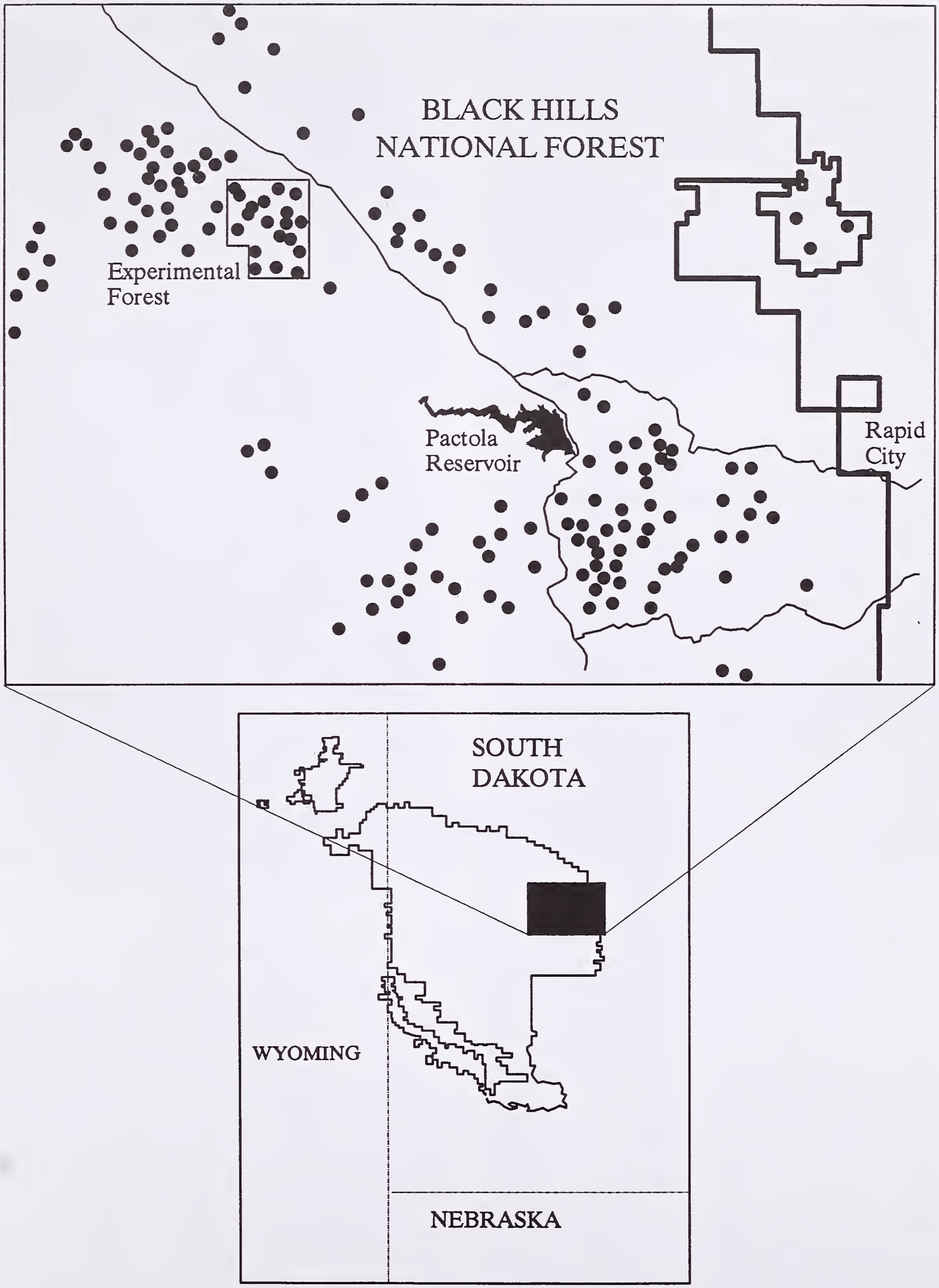

Figure 1. — Location of study area sampled to determine bird use within 13 forest structural stages, 1992-94.

clear-cutting, and include grass-forb, shrub-seedling (<2.5 cm DBH), sapling-pole (2.5–22.9 cm DBH), mature (>23 cm DBH), and old-growth. Structural stages of sapling-pole and mature trees are further stratified by overstory cover: 0–40%, 41–70%, and 71–100%. Meadows were described as wet (subirrigated) and dry (upland grasslands).

In 1992, we selected 7 stands in each DBH and overstory cover structural stage of sapling-pole and mature ponderosa pine (42 stands), 6 stands in old-growth ponderosa pine, 7 stands in shrub-seedling aspen/birch, 7 stands in each overstory cover structural stage of sapling-pole aspen/birch (21 stands), 7 wet meadows, and 4 dry meadows. Stands were initially selected from 1:24,000 aerial photographs and field verified prior to sampling.

Current management in the Black Hills seldom includes clear-cutting ponderosa pine. Thus, grass-forb and shrub-seedling structural stages of ponderosa pine were not included in our study. Aspen/birch commonly occurs in drainages, and these stands are vegetatively different from monotypic aspen stands (Severson and Thilenius 1976). Of the 7 sapling-pole stands of aspen/birch, we included 3 from monotypic aspen/birch communities and 4 from aspen/birch drainages.

Within each stand identified above we selected 3 sites for counting birds. In ponderosa pine, monotypic aspen, and dry meadows, these sites were 150–200 m apart and 150 m from an edge to avoid counting bird species in adjacent habitats and to avoid double counting individuals (Manuwal and Carey 1991, Robbins et al. 1989). In the aspen/birch drainages and wet meadows, sites were located >150 m apart, in center of the drainage; these typically are narrow corridors and selecting sites 150 m from edge was not possible. We tested the existing HABCAP model with bird counts from 261 sites in 87 stands.

In 1994, we selected new stands and sites for a different-time-and-location test of the HABCAP model. We selected 7 stands in each overstory cover category of sapling-pole ponderosa pine, mature ponderosa pine, and old-growth ponderosa pine (42 stands), 7 stands in shrub-seedling aspen/birch, 7 stands in each overstory cover category of sapling-pole aspen/birch (21 stands), 7 wet meadows, and 7 dry meadows. Sapling-pole aspen/birch included 4 stands in drainages and 3 monotypic stands. Within each stand identified, we selected 2 sites for bird counts using the same criteria for spacing as in the initial test. We collected these data from 176 sites in 88 stands.

Bird Counts

At each site, we counted breeding birds for 2 consecutive days during 2 sample sessions each year (4 counts/site/year during the study). Breeding bird counts extended from about 15 May to 7 July to maximize the probability of detecting species present (Ralph et al. 1993, Robbins et al. 1989). Bird counts were not conducted during periods of moderate to heavy rain, strong wind (>10 km/hr), or temperatures <7°C or >24°C (Manuwal and Carey 1991). Observers were experienced, and were trained for visual and audio identification of birds and estimation of distances prior to field sampling (Verner and Milne 1989). We used 3 observers during 1992–1993 and 2 observers in 1994. Each observer counted birds on different sites during each sample session and reversed the sample order between days to decrease bias and maximize the number of species detected (Verner and Milne 1989). We began counting birds at sunrise, and all counts were completed by 11:00 am (Manuwal and Carey 1991).

Bird counts were made using point counts, and we estimated the distance to each bird (Reynolds et al. 1980). We recorded all birds seen or heard during counts 8 minutes in duration (Verner 1988) beginning when the observer arrived at the census point (Ralph et al. 1993). We recorded the 5-minute mark of each count so standardized 5-minute counts could be extracted from these data (Ralph et al. 1993). Birds flushed within 100 m of the census point were tallied in the count. We also recorded whether birds observed were within the structural stage being sampled, sex of the bird, and its activity.

Data Analysis

Coefficients in the HABCAP model quantify relative (0 to 1.0) capability of each structural stage as habitat to sustain a prescribed population density for each species. The HABCAP model includes separate coefficients for feeding and cover. Although feeding and cover coefficients are the same for most species, we based our test of the model on cover coefficients because cover includes nest placement in breeding territories. Abundance of bird species at each site was the sum of observations ≤50 m from the count point. We used bird count data from 1992 and 1993 to test hypotheses that the observed abundance in each structural stage was similar to predicted abundance by the HABCAP model using chi-square goodness-

of-fit tests (Freese 1960). Chi-square tests were made only for structural stages with coefficients >0. Since fewer counts were made in old-growth and dry meadows, predicted abundance in these structural stages was adjusted to represent the proportion of total count days. Predicted abundance of bird species (PN_j) in each structural stage (SS_i) was calculated as:

$$PN_j = \frac{C_{ss_{ij}}}{\sum_{i}^{n} C_{ss_{ij}}} \times N_j$$

the cover coefficient in structural stage i for species j (C_{ssij}) divided by the sum for n structural stages of cover coefficients for species j; this value was multiplied times the total from our counts of species j in all structural stages (N_j). A chi-square statistic with $P \leq 0.05$ indicated lack of fit by the model. We then constructed 95% confidence intervals around the proportion of observations in each structural stage (Fleiss 1981). If the coefficient for a species for a structural stage was 0, a single observation resulted in failure of the model to fit for that structural stage.

HABCAP model coefficients were revised through ≥1 iterations of the following process. Following a significant chi-square statistic or when the expected proportion of abundance was outside the confidence interval around the observed proportion, new coefficients were assigned. We then recalculated the predicted, and abundance computed a new chi-square test statistic and confidence intervals. We assigned new coefficients for species not in the model based on abundance, then evaluated these coefficients using the process described.

Validation of habitat capability models requires a series of tests of model predictions (Block et al. 1994). Thus, we then tested the hypothesis that the revised HABCAP model fit the observed patterns of bird abundance in structural stages using data from 1994. If the latter hypothesis was rejected for a species, we further revised the coefficients using data from all 3 years combined to develop final HABCAP model coefficients.

RESULTS AND DISCUSSION

Sixty-nine nongame bird species were observed in our study, 11 of which were included in the existing HABCAP model. HABCAP coefficients for these 11 species are displayed in table 2. Nine species not included in the model occurred in sufficient abundance to develop coefficients based on 1992–1993 data (table 3). Our recommended final HABCAP model coefficients for 20 species in 13 structural stages are in table 4. To simplify data presentation, all intermediate statistical tables appear in the appendix.

Table 2. Existing habitat capability model coefficients for nongame birds for ponderosa pine, aspen/birch, and meadow structural stages in the Black Hills[1,2].

	Ponderosa pine							Quaking aspen					
	Sapling-pole			Mature					Sapling-pole			Meadows	
	<40	41–70	>70	<40	41–70	>70	OG[3]	SS[3]	<40	41–70	>70	Wet	Dry
Northern flicker	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Red-naped sapsucker	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5	1.0	1.0	0.0	0.0
Hairy woodpecker	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.2	0.2	0.2	0.0	0.0
White-breasted nuthatch	0.0	0.0	0.0	0.5	0.5	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Red-breasted nuthatch	0.2	0.2	0.2	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Ruby-crowned kinglet	0.2	0.2	0.2	0.5	1.0	1.0	1.0	0.0	0.5	0.5	0.5	0.0	0.0
Mountain bluebird	0.0	0.0	0.0	1.0	0.5	0.2	0.5	0.0	0.0	0.0	0.0	0.5	0.2
Warbling vireo	0.2	0.2	0.0	0.2	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0
MacGillivray's warbler	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.5	0.2	0.0	0.0
Ovenbird	0.2	0.2	0.2	0.5	0.5	0.2	0.5	0.5	0.5	0.5	0.5	0.0	0.0
Vesper sparrow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0

[1] *Based on cover coefficients from the existing R-2 HABCAP model at the outset of our study.*
[2] *Structural stage categories and acronyms taken from Buttery and Gillam (1983).*
[3] *OG = old-growth and SS = shrub-seedling structural stages.*

Table 3. HABCAP model coefficients for 9 nongame bird species added to the HABCAP model in 13 DBH and overstory cover structural stages of ponderosa pine, aspen/birch, and meadows in the Black Hills[1,2].

	Ponderosa pine							Quaking aspen					
	Sapling-pole			Mature					Sapling-pole			Meadows	
	<40	41–70	>70	<40	41–70	>70	OG[3]	SS[3]	<40	41–70	>70	Wet	Dry
Dusky flycatcher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.9	0.7	0.1	0.0
Gray jay	0.1	0.2	0.2	0.3	1.0	0.9	0.3	0.0	0.0	0.0	0.0	0.2	0.0
Black-capped chickadee	0.5	0.9	0.8	0.8	0.9	0.7	0.9	0.8	0.7	1.0	0.8	0.1	0.0
Townsend's solitaire	0.8	0.8	1.0	0.7	0.7	0.5	0.2	0.1	0.1	0.2	0.1	0.1	0.0
American robin	0.2	0.3	0.2	0.3	0.1	0.1	0.1	0.2	0.5	1.0	0.4	0.0	0.0
Yellow-rumped warbler	0.6	1.0	0.9	0.7	1.0	0.9	0.6	0.1	0.2	0.4	0.3	0.0	0.0
Chipping sparrow	0.7	0.2	0.3	0.8	0.2	0.1	0.3	0.9	1.0	0.7	0.2	1.0	0.0
Dark-eyed junco	0.9	0.6	0.2	1.0	0.5	0.4	0.4	1.0	0.7	0.6	0.5	0.2	0.0
Western tanager	0.2	0.4	0.2	0.4	0.3	0.2	1.0	0.0	0.1	0.1	0.2	0.0	0.0

[1] *Based on bird abundance during 1992-1993.*
[2] *Structural stage categories and acronymns taken from Buttery and Gillam (1983).*
[3] *OG = old-growth and SS = shrub-seedling structural stages.*

Table 4. Final HABCAP model coefficients for 20 nongame birds in 13 DBH and overstory structural stages of ponderosa pine, aspen/birch, and meadows of the Black Hills[1,2].

	Ponderosa pine							Aspen/birch					
	Sapling-pole			Mature					Sapling-pole			Meadows	
	<40	41–70	>70	<40	41–70	>70	OG[3]	SS[3]	<40	41–70	>70	Wet	Dry
Northern flicker	0.7	0.5	0.1	1.0	0.6	0.1	0.1	0.8	0.6	0.5	0.4	0.0	0.0
Red-naped sapsucker	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.4	0.3	1.0	0.6	0.0	0.0
Hairy woodpecker	1.0	0.7	0.3	0.7	0.5	0.4	0.7	0.4	0.4	0.7	0.7	0.0	0.0
Dusky flycatcher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.6	0.6	0.0	0.0
Gray jay	0.1	0.2	0.2	0.5	1.0	1.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0
Black-capped chickadee	0.5	0.9	0.8	0.8	0.9	0.7	0.9	0.8	0.7	1.0	0.8	0.1	0.0
White-breasted nuthatch	0.2	0.5	0.3	0.2	0.4	0.3	0.3	0.0	0.1	0.2	0.2	0.0	0.0
Red-breasted nuthatch	0.5	0.5	0.8	0.3	0.8	0.8	1.0	0.1	0.1	0.2	0.4	0.0	0.0
Ruby-crowned kinglet	0.0	0.0	0.0	0.2	0.4	0.9	1.0	0.4	0.3	0.7	0.7	0.0	0.0
Mountain bluebird	1.0	0.0	0.0	0.7	0.0	0.1	0.0	0.6	0.6	0.3	0.0	0.0	0.0
Townsend's solitaire	0.8	0.9	1.0	0.5	0.7	0.5	0.4	0.1	0.1	0.2	0.1	0.0	0.0
American robin	0.6	0.4	0.2	0.5	0.3	0.2	0.2	0.3	0.9	1.0	0.5	0.0	0.0
Warbling vireo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.4	0.5	0.0	0.0
Yellow-rumped warbler	0.6	1.0	0.9	0.7	1.0	0.9	0.8	0.1	0.1	0.3	0.3	0.0	0.0
MacGillivray's warbler	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.5	0.2	0.0	0.0
Ovenbird	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.3	0.5	0.0	0.0
Vesper sparrow	0.1	0.0	0.0	1.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	1.0
Chipping sparrow	1.0	0.1	0.2	0.5	0.2	0.1	0.3	0.7	0.8	0.5	0.2	0.8	0.0
Dark-eyed junco	0.9	0.6	0.2	1.0	0.5	0.4	0.4	1.0	0.7	0.6	0.5	0.2	0.0
Western tanager	0.3	0.6	0.2	0.5	0.3	0.2	1.0	0.0	0.1	0.1	0.2	0.0	0.0

[1] *Based on bird abundance from 1992-1994.*
[2] *Structural stage categories and acronymns taken from Buttery and Gillam (1983).*
[3] *OG = old-growth and SS = shrub-seedling structural stages.*

Birds in Existing HABCAP Model

Northern Flicker

The existing HABCAP model (table 2) suggested that mature and old-growth structural stages of ponderosa pine had high habitat capability for northern flickers (scientific names of birds are in table 5); all aspen and sapling-pole ponderosa pine structural stages were considered unsuitable. Observed abundance of northern flickers among structural stages differed ($P < 0.01$) from predicted abundance (Appendix table A-1). The model underestimated northern flicker abundance in aspen and in sapling-pole structural stages of ponderosa pine, and overestimated abundance in mature structural stages of ponderosa pine. Northern flicker abundance appeared similar across vegetation types, with greater abundance in low to moderate overstory cover structural stages. In the revised model, coefficients for sapling-pole ponderosa pine and all aspen structural stages were increased and coefficients for mature ponderosa pine with >40% overstory cover and old-growth ponderosa pine were decreased. Northern flicker use of the shrub-seedling stage of aspen was due to the presence of snags in aspen cuts. The coefficient for shrub-seedling aspen is dependent on continued existence of snags in this structural stage.

Table 5. Common and scientific names of birds with adequate abundance to test the HABCAP model in the Black Hills, South Dakota

Common name	Scientific name
Northern flicker	*Colaptes auratus*
Red-naped sapsucker	*Sphyrapicus nuchalis*
Hairy woodpecker	*Picoides villosus*
White-breasted nuthatch	*Sitta carolinensis*
Red-breasted nuthatch	*Sitta canadensis*
Ruby-crowned kinglet	*Regulus calendula*
Mountain bluebird	*Sialia currucoides*
Warbling vireo	*Vireo gilvus*
MacGillivray's warbler	*Oporornis tolmiei*
Ovenbird	*Seiurus aurocapillus*
Vesper sparrow	*Pooecetes gramineus*
Dusky flycatcher	*Empidonax oberholseri*
Gray jay	*Perisoreus canadensis*
Black-capped chickadee	*Parus atricapillus*
Townsend's solitaire	*Myadestes townsendi*
American robin	*Turdus migratorius*
Yellow-rumped warbler	*Dendroica coronata*
Chipping sparrow	*Spizella passerina*
Dark-eyed junco	*Junco hyemalis*
Western tanager	*Piranga ludoviciana*

Because northern flickers were uncommon in 1994, we were not able to perform the different-time-and-location validation. Combined northern flicker (1992–1994) abundance did not differ ($P = 0.46$) from predicted abundance based on 1992–1993 revised model coefficients (table A-2). Although past research has suggested northern flickers are associated with many large trees, high overstory cover (Anderson and Shugart 1974), and older aged stands (Gilbert and Allwine 1991, Ralph et al. 1991), northern flickers also occur in young forests (Aney 1984). In the Black Hills, density (rather than size) of snags, overstory cover, or age of stand, may be more important in determining northern flicker abundance. Northern flickers typically feed on the ground with open understory (Verner 1984). Patterns of use suggest selection of shrub-seedling, sapling-pole, and mature stands with little or no overstory cover by northern flicker. Some use of shrub-seedling and open-canopied structural stages may have been by feeding birds nesting in adjacent stands. We also observed northern flickers in meadows, but these observations were omitted because we did not test feeding coefficients.

Red-naped Sapsucker

The red-naped sapsucker is found in mixed aspen and pine habitats of the Rocky Mountains (Finch and Reynolds 1987). The HABCAP model for the Black Hills indicated sapling-pole aspen was the best habitat, but ponderosa pine was also capable of supporting red-naped sapsuckers (table 2). Red-naped sapsucker abundance differed ($P < 0.01$) from predicted abundance, primarily because the existing model overestimated abundance in all ponderosa pine structural stages except mature ponderosa pine with >70% overstory cover. Our revised HABCAP model (table 4) showed aspen as suitable, with pine being of relative low quality. Aspen/birch with moderate (41–70%) overstory cover was considered optimal habitat for red-naped sapsuckers based on 1992–1993 data.

Red-naped sapsucker abundance declined in 1994 in most structural stages. Low numbers precluded a good chi-square test of the model. Red-naped sapsucker abundance for all years combined, however, did not differ ($P = 0.92$) from predicted abundance based on revised coefficients. Red-naped sapsuckers usually select live trees for nesting (Daily 1993, Runde

and Capen 1987), usually aspen trees susceptible to heart rot (Crockett and Hadow 1975). Tree species and its condition or degree of heart rot (Daily 1993), rather than vegetative structural stages, are important in determining habitat capability for red-naped sapsuckers. As with other cavity-nesting species, model coefficients for shrub-seedling aspen (trees ≤2.5 cm DBH) are dependant on the retention of suitable snags for nesting.

Hairy Woodpecker

Hairy woodpeckers were the most abundant primary cavity-nesting species in this study, and the existing HABCAP model did not ($P < 0.01$) predict the observed abundance among structural stages. The existing HABCAP model predicted sapling-pole, mature, and old-growth ponderosa pine structural stages were equally optimal habitats for hairy woodpeckers, and that sapling-pole structural stages of aspen were only moderately suitable (table 2). During 1992–1993, hairy woodpeckers were more abundant in the open to moderate overstory cover structural stages of ponderosa pine, old-growth ponderosa pine, and the moderate to high overstory cover sapling-pole structural stages of aspen ($P < 0.05$). Hairy woodpeckers also occurred in shrub-seedling structural stages of aspen that contained snags.

Hairy woodpecker abundance in 1994 differed ($P < 0.01$) from predicted abundance in the revised HABCAP model. However, across all years, hairy woodpecker abundance data did not differ ($P = 0.61$) from predicted abundance based on the revised HABCAP model coefficients. Lack of fit by the model in 1994 probably reflected annual variation in abundance. Hairy woodpeckers usually occur in interior portions of managed forests (Aney 1984) and old-growth stands, depending on large snag abundance (Marshall 1988, Zarnowitz and Manuwal 1985). Hairy woodpeckers are strong excavators that can excavate nests in a wide variety of substrates (Runde and Capen 1987). Thus, snag size or density may be more important than vegetative structural stages for predicting hairy woodpecker abundance (Runde and Capen 1987, Zarnowitz and Manuwal 1985).

White-breasted Nuthatch

Mature and old-growth structural stages of ponderosa pine had high habitat capability for white-breasted nuthatches in the existing HABCAP model; sapling-pole ponderosa pine and all aspen structural stages were predicted to be unsuitable (table 2). Observed abundance of white-breasted nuthatches differed ($P < 0.01$) from predicted abundance among structural stages in the existing model. More white-breasted nuthatches ($P < 0.05$) occurred in sapling-pole ponderosa pine and aspen than predicted by the existing HABCAP model. We also found fewer ($P < 0.05$) white-breasted nuthatches than predicted in mature with <70% overstory cover and old-growth structural stages of ponderosa pine than predicted by the existing model. Revised HABCAP model coefficients for sapling-pole structural stages of ponderosa pine and aspen were increased and coefficients for mature ponderosa pine with <70% overstory cover were decreased.

White-breasted nuthatch abundance in 1994 differed ($P < 0.01$) from predicted abundance based on the revised HABCAP model. White-breasted nuthatch abundance for all years combined also differed ($P < 0.01$) from predicted abundance in the revised. These differences were due to higher ($P < 0.05$) than predicted abundance in old-growth ponderosa pine. White-breasted nuthatches occur in a wide variety of vegetative structural stages including old-growth ponderosa pine (Aney 1984), open woodlands and forest edges (DeGraaf et al. 1991). Both deciduous and coniferous forests with DBH classes >2.5 cm provided habitat for white-breasted nuthatches in the Black Hills. White-breasted nuthatches in Arizona frequently utilized natural cavities in live oak trees (Cunningham et al. 1980, Kilham 1968) and thus, may not be entirely dependent on snags for nest sites.

Red-breasted Nuthatch

During 1992–1993, red-breasted nuthatch abundance differed ($P < 0.01$) from that predicted by the existing HABCAP model. More ($P < 0.05$) red-breasted nuthatches occurred in sapling-pole structural stages of ponderosa pine with >40% overstory cover than predicted by the existing model. The existing model predicted more red-breasted nuthatches in mature pine with <40% overstory cover (P4A) than we observed, but underestimated use of aspen structural stages. In the revised HABCAP model, capability of sapling-pole ponderosa pine and aspen to support red-breasted nuthatches was increased while capability of mature ponderosa pine with low overstory cover for was decreased.

Abundance of red-breasted nuthatches in 1994 differed ($P < 0.01$) from predicted abundance based on the revised HABCAP model. The revised model only marginally fit abundance patterns among structural

stages for all years (P = 0.08). However, we made some modifications for the final HABCAP model because the predicted proportion of use in old-growth ponderosa pine was outside the confidence intervals predicted by the revised HABCAP model. Increased overstory cover appeared to be more important than average DBH of a stand and to a lesser extent vegetation type in determining red-breasted nuthatch abundance. Red-breasted nuthatches have been associated with old-growth interior coniferous forests (Ralph et al. 1991, Aney 1984), but may also occur in deciduous and mixed coniferous/deciduous habitats (DeGraaf et al. 1991). Red-breasted nuthatch abundance declined following logging of a coniferous forest in California (Kilgore 1970).

Ruby-crowned Kinglet

Observed abundance of ruby-crowned kinglets differed (P < 0.01) from that predicted by the existing HABCAP model. The model predicted that mature ponderosa pine structural stages with moderate to high overstory cover and old-growth ponderosa pine were optimal habitat; the remaining pine and aspen structural stages were moderately suitable (table 2). Abundance of ruby-crowned kinglets in sapling-pole ponderosa pine, mature ponderosa pine with low overstory cover, and sapling-pole aspen with low overstory cover was overestimated (P < 0.05) and abundance in sapling-pole aspen with >40% overstory cover was underestimated (P < 0.05) by the existing HABCAP model.

In 1994, there were insufficient numbers of ruby-crowned kinglets to adequately test the revised model. Ruby-crowned kinglet abundance for all three years combined did not differ (P = 0.99) from predicted abundance in the revised model. Habitat capability for ruby-crowned kinglets approached optimal in mature and old-growth ponderosa pine structural stages with high overstory cover and large DBH. Ruby-crowned kinglets were most abundant in partially-cut and unlogged areas of a western larch (*Larix occidentalis*)/Douglas-fir (*Pseudotsuga menziesii*) forest in Montana, with most activity occurring at the stand edges (Tobalske et al. 1991). All sapling-pole structural stages of ponderosa pine were unsuitable for ruby-crowned kinglets. In mixed coniferous/deciduous forests, ruby-crowned kinglets may become restricted to aspen following harvesting of coniferous trees (Franzreb and Ohmart 1978). Thus, increased ruby-crowned kinglet abundance in moderate to dense sapling-pole aspen may reflect use of edge habitats or a decrease in suitable coniferous habitat.

Mountain Bluebird

Mountain bluebirds nest in open forests and edges throughout the Rocky Mountain region (DeGraaf et al. 1991). The existing HABCAP model predicted mature ponderosa pine with low overstory cover was optimal habitat for mountain bluebirds (table 2), but observed abundance differed (P < 0.01) from predicted. Specifically, the existing model overestimated (P < 0.05) mountain bluebird abundance in mature and old-growth ponderosa pine structural stages and underestimated (P < 0.05) abundance in sapling-pole ponderosa pine with <40% overstory cover, shrub-seedling aspen, and open to moderate overstory cover (<70% overstory cover) sapling-pole aspen.

Mountain bluebirds were abundant in wet and dry meadows. The existing model shows wet and dry meadows to be moderately suitable for mountain bluebirds. In the Black Hills, nesting by mountain bluebirds in wet and dry meadows is limited by nest box construction or suitable nest sites in adjacent habitats. Otherwise, observations of mountain bluebirds in meadows were most likely birds that were feeding. Revised HABCAP model coefficients for ponderosa pine and aspen structural stages with low overstory cover were near optimal; structural stages with closed canopies have low capabilities for mountain bluebirds.

Mountain bluebird abundance in 1994 did not differ (P = 0.07) from predicted abundance based on revised coefficients. Shrub-seedling aspen and ponderosa pine with <40% overstory cover often result from logging, and mountain bluebird use of these structural stages depends on suitable snags for cavities. Cover coefficients for wet and dry meadows should be near 0 because mountain bluebird nesting in these structural stages is dependent on artificial structures.

Warbling Vireo

The warbling vireo is common in aspen throughout the Rocky Mountain region (Finch and Reynolds 1987). In the Black Hills, warbling vireos also occur in mixed conifer and deciduous stands (unpublished data, Rocky Mountain Forest and Range Experiment Station, Rapid City, SD). Predicted abundance of warbling vireos in the existing HABCAP model differed from observed abundance (P < 0.01) because lower (P < 0.05) than predicted abundance occurred

in low to moderate overstory cover categories of sapling-pole ponderosa pine and mature ponderosa pine with <40% overstory cover. The existing HABCAP model predicted equal selection of all aspen/birch structural stages (table 2). Although the existing model predicted low habitat capability in sapling-pole and open mature structural stages of ponderosa pine, our data suggests that sapling-pole and mature structural stages of ponderosa pine are not selected by warbling vireos. Although we observed warbling vireos in all structural stages of ponderosa pine, they were associated with small inclusions of aspen within the pine. Because we rounded coefficients <0.05 to 0, structural stages of ponderosa pine showed no capability to support warbling vireos in the final model. The coefficient for shrub-seedling aspen was revised to 0.4 to reflect lower ($P < 0.05$) than predicted abundance.

In 1994, warbling vireo abundance differed ($P = 0.04$) from that predicted by our revision based on 1992–1993 counts. Warbling vireo abundance for all years combined also differed ($P < 0.01$) from the predictions of our revised model. Old-growth ponderosa pine in the Black Hills often has deciduous inclusions, and warbling vireos occur in this structural stage in some years. Warbling vireo abundance in 1994 was overestimated in the revised model for old-growth ponderosa pine and the sapling-pole aspen with moderate (41–70%) overstory cover structural stages. Our final model showed all structural stages of ponderosa pine and meadows are unsuitable for warbling vireos (table 4).

Warbling vireos most often occur in deciduous forested stands (Ralph et al. 1991, James 1976). In Douglas-fir/hardwood stands in California and Oregon, warbling vireos were positively ($P \leq 0.01$) correlated to hardwoods and negatively correlated to conifers (Ralph et al. 1991). Therefore, abundance of warbling vireos in ponderosa pine is dependent on hardwoods within the stands. The HABCAP model cannot accurately model subdominant occurrence of vegetation communities within stands.

MacGillivray's Warbler

MacGillivray's warblers occurred only in aspen structural stages, and usually in aspen/birch drainages. Although the existing model adequately predicted abundance of MacGillivray's warblers in aspen ($P = 0.09$, table 2), we revised the coefficient for shrub-seedling aspen to 0.5 because the predicted proportional abundance did not ($P < 0.05$) include observed abundance in this structural stage. Ponderosa pine and meadows were not selected by MacGillivray's warblers.

MacGillivray's warbler abundance in 1994 was too low to make an independent test of the revised model. Data for all years showed abundance did not differ ($P = 0.40$) from predicted abundance based on the revised model. MacGillivray's warblers prefer early successional stages of aspen (Scott and Crouch 1988, Morrison 1981). Griscom and Sprunt (1979) found MacGillivray's warblers in vegetative communities with serviceberry, snowberry, ninebark, wild spirea, and riparian willows (*Salix* spp.). These habitat conditions are typical in shrub-seedling aspen and open cover aspen/birch drainages in our study.

Ovenbird

Observed abundance of ovenbirds during 1992–1993 differed ($P < 0.01$) from that predicted by the existing HABCAP model. The existing model predicted optimal habitat for ovenbirds occurred in mature and old-growth aspen. However, these structural stages did not occur in our study area. The existing model overestimated ($P < 0.05$) ovenbird abundance in open canopied sapling-pole ponderosa pine and aspen and open to moderate overstory cover in mature ponderosa pine. The existing model underestimated ($P < 0.05$) ovenbird abundance in old-growth ponderosa pine, shrub-seedling aspen, and sapling-pole aspen with high overstory cover. We found the greatest abundance of ovenbirds in old-growth ponderosa pine and sapling-pole aspen with high overstory cover. Revised model coefficients for sapling-pole ponderosa pine, mature ponderosa pine, and sapling pole aspen with low to moderate overstory cover were decreased; the coefficient for shrub-seedling aspen was increased to 0.1.

In 1994, ovenbird abundance was not ($P < 0.01$) predicted by the revised HABCAP model. Combined counts from 1992–1994 also differed ($P < 0.01$) from the predictions of the revised model. Despite a coefficient indicative of low habitat capability, observed ovenbird abundance in the test of the revised model was lower ($P < 0.05$) than predicted in sapling-pole ponderosa pine with >40% overstory cover. We also found more ($P < 0.05$) ovenbirds in sapling-pole aspen with >70% overstory cover than predicted by the revised model. Our final model showed that, of the vegetative structural stages sampled, sapling-pole aspen with >70% overstory cover had the highest habitat capability for ovenbirds. Sapling-pole and mature ponderosa pine and shrub-seedling aspen

structural stages were unsuitable for ovenbirds in the final model (table 4).

Ovenbirds are often considered forest interior (Kroodsma 1984), but we observed them in small, fragmented aspen patches. The ecological relationships of ovenbirds in these small patches should be further investigated. Our data suggests that overstory cover is the most important determinant of ovenbird abundance in aspen.

Vesper Sparrow

Vesper sparrows prefer grassland/sagebrush habitats for nesting on the Northern Great Plains (Schaid et al. 1983). The dispersion of vesper sparrows among structural stages differed ($P < 0.01$) from that predicted by the existing HABCAP model. Forested structural stages (>2.5 cm DBH) were unsuitable habitat for vesper sparrows in the existing model; meadows and shrub-seedling aspen were optimal (table 2). Dry meadows and both structural stages of ponderosa pine with <40% overstory cover were selected more ($P < 0.05$) than predicted by the existing model. Fewer ($P < 0.05$) vesper sparrows were observed in shrub-seedling aspen and wet meadows than predicted by the existing model. We increased model coefficients for structural stages of ponderosa pine with <40% overstory cover and decreased coefficients for shrub-seedling aspen and wet meadows in the revised model.

Vesper sparrows were observed only in dry meadows in 1994; thus, data for all years were used to test the revised model. Vesper sparrow abundance differed ($P < 0.01$) from that predicted by the revised HABCAP model. Our initial changes to the model overemphasized the habitat capability of open canopy ponderosa pine ($P < 0.05$). Consequently, observed abundance of vesper sparrows in dry meadows was greater ($P < 0.05$) than that predicted.

Abundance of vesper sparrows within grasslands, is closely related to the presence of shrubs (Schaid et al. 1983, Best 1972). In our study, dry meadows frequently included snowberry as a shrub component. Several of the mature open canopy pine stands had been recently harvested, and the scattered logging slash and grass understory may have provided suitable nest habitat for vesper sparrows.

Birds Added to HABCAP Model

The following species were not included in the existing HABCAP model. We developed coefficients for them based on relative abundance within structural stages from 1992–1993 bird counts (table 3). Model coefficients for these species were tested using bird counts from 1994 or from all years combined.

Dusky Flycatcher

The dusky flycatcher occurs in aspen (Finch and Reynolds 1987) or low- to intermediate-density forests with understory shrubs (Degraaf et al. 1991). Both the 1994 and combined (1992–1994) abundances differed ($P \leq 0.02$) from that predicted by coefficients developed from 1992–1993 bird counts. Fewer ($P < 0.05$) than predicted observations occurred in sapling-pole aspen with moderate overstory cover. Dusky flycatchers are most often found in young aspen stands (Ralph et al. 1991) and are more reproductively successful in stands with higher densities of small trees (Kelly 1993). Final HABCAP coefficients for dusky flycatchers showed shrub-seedling stages of aspen as optimal habitat; habitat capability decreased in more mature and high overstory cover stands (table 4). Ponderosa pine and meadows are unsuitable for dusky flycatchers.

Gray Jay

In 1994, the observed abundance of gray jays among structural stages differed ($P < 0.01$) from the predicted abundance based on coefficients from 1992–1993 bird counts. Combined gray jay abundance across all years adequately modeled ($P = 0.20$) abundance patterns among structural stages. However, the coefficient for sapling-pole aspen with 41–70% overstory cover predicted higher ($P < 0.05$) proportional use than we observed. The coefficient for this structural stage was revised in the final HABCAP coefficients.

Dense conifer forest is considered optimal habitat for gray jays (Ralph et al. 1991, Johnsgard 1979), and the coefficients we propose corroborate that for ponderosa pine in the Black Hills. Our final HABCAP coefficients increased with size and overstory cover of ponderosa pine, then declined in old-growth stands. Aspen and meadows provide little or no habitat for gray jays.

Black-capped Chickadee

Black-capped chickadees were common in pine and aspen structural stages of the Black Hills. Abundance of chickadees among structural stages in 1994 differed ($P < 0.01$) from the predicted patterns based on coefficients from 1992–1993 bird counts, but

abundance for all years did not differ ($P = 0.39$) from that predicted by our initial coefficients.

Black-capped chickadees have wide tolerance for habitat conditions and occur in forests from clearcuts to old-growth (Tobalske et al. 1991, Aney 1984). Factors other than vegetative structural stages may be more important in determining black-capped chickadee abundance in the Black Hills. Black-capped chickadees are both primary and secondary cavity-nesters (Conner 1978), and snags or trees with advanced wood decay may be important in determining their occupation of a site (Runde and Capen 1987). Final HABCAP coefficients indicated moderate to high habitat quality in all structural stages of pine and aspen.

Townsend's Solitaire

Abundance of Townsend's solitaires among structural stages in 1994 and all years differed ($P < 0.01$) from predicted patterns based on model coefficients from 1992–1993 bird counts. We observed more ($P < 0.05$) Townsend's solitaires than predicted in old-growth ponderosa pine and fewer ($P < 0.05$) than predicted in mature ponderosa pine with low overstory cover. Our data showed that sapling-pole ponderosa pine provided the greatest habitat capability for Townsend's solitaires. All structural stages of aspen provide low habitat capability for Townsend's solitaires. Habitat capability for Townsend's solitaires increased with canopy cover in our young pine stands. Elsewhere, Townsend's solitaires also preferred small conifer trees or tall shrub thickets (Ralph et al. 1991, Verner and Boss 1980).

American Robin

Our initial HABCAP coefficients from 1992–1993 data did not predict ($P < 0.01$) abundance patterns of American robins among structural stages in 1994 nor all years combined. Observed abundance was higher ($P < 0.05$) than that predicted in sapling-pole ponderosa pine with low overstory cover and mature ponderosa pine with moderate overstory cover, but lower ($P < 0.05$) than predicted in sapling-pole aspen with moderate overstory cover. American robins occurred most often in both ponderosa pine and aspen stands with low to moderate overstory cover; sapling-pole aspen with 41–70% overstory cover was optimal habitat.

American robins are associated with younger forest stands (Gilbert and Allwine 1991), and patterns of use among structural stages indicate its association with edge habitats (Tobalske et al. 1991). American robins are usually more successful nesting in deciduous trees than in coniferous trees (Knupp et al. 1977). Thus, final model coefficients in aspen were greater than for ponderosa pine. Meadows do not provide suitable nest sites for American robins, but are used extensively for feeding.

Yellow-rumped Warbler

Distribution of yellow-rumped warblers among structural stages in 1994 and all years combined differed ($P < 0.01$) from that predicted based on coefficients estimated from 1992–1993 bird counts. Abundance was higher ($P < 0.05$) than predicted in old-growth ponderosa pine, but lower ($P < 0.05$) than predicted in sapling-pole aspen with low to moderate overstory cover.

Abundance of yellow-rumped warblers declines as coniferous tree density and overstory cover decreases (Szaro and Balda 1979a). Yellow-rumped warblers are typically found in coniferous forests (Ralph et al. 1991, Aney 1984, Kilgore 1970), but increase use of aspen following harvest of conifers (Franzreb 1983). Final HABCAP coefficients depict the greater habitat capability of ponderosa pine versus aspen for yellow-rumped warblers.

Chipping Sparrow

Chipping sparrow abundance among structural stages in 1994 and for all years differed ($P < 0.01$) from that predicted by HABCAP coefficients estimated from 1992–1993 bird counts. Proportional use was higher ($P < 0.05$) than predicted in open sapling-pole ponderosa pine and lower ($P < 0.05$) than that predicted in mature ponderosa pine with low overstory cover. Final HABCAP coefficients show open canopy ponderosa pine, aspen, and wet meadows have higher habitat capability for chipping sparrows than those with closed canopies. Clearcuts and edge habitats adjacent to open forests appear to be preferred by chipping sparrows (Tobalske et al. 1991).

Dark-eyed Junco

Dark-eyed juncos preferred open canopy structural stages of both ponderosa pine and aspen. Abundance among structural stages in 1994 differed ($P < 0.01$) from that predicted by our initial coefficients. However, abundance of dark-eyed juncos for all years did not differ ($P = 0.70$) from that predicted by our model coefficients. Abundance declines in forested habitats as overstory cover increases.

Dark-eyed juncos nest and forage on the ground (Smith and Andersen 1982). Because of the inverse relationship of understory vegetation with overstory cover (Severson and Uresk 1988), open canopy forests have more nesting cover and vegetation for foraging.

Western Tanager

Western tanager abundance among structural stages in 1994 and for all years combined differed ($P < 0.01$) from that predicted by initial HABCAP coefficients from 1992–1993 bird counts. Observed abundance was higher ($P < 0.05$) than predicted in sapling-pole ponderosa pine structural stages with moderate overstory cover, but lower ($P < 0.05$) than predicted in shrub-seedling aspen. Our final HABCAP model coefficients showed old-growth ponderosa pine as most suitable for western tanagers. Sapling-pole ponderosa pine with 41–70% overstory cover and mature ponderosa pine with <40% overstory cover support moderate numbers of western tanagers (table 4). Aspen provides little or no habitat for western tanagers. Western tanagers occur in all structural stages of conifers (Gilbert and Allwine 1991, Ralph et al. 1991) and abundance doesn't change greatly following timber harvest (Aney 1984, Kilgore 1970).

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APPENDIX A
Chi-square evaluation of existing and revised HABCAP model.

Table A-1. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for northern flicker in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Existing HABCAP Coeff.	Expected Proportion[1]	Number Observed N=104	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.0	0.00	13	0.06–0.19	0.7	0.13
P3B	0.0	0.00	10	0.03–0.16	0.5	0.09
P3C	0.0	0.00	2	0.00–0.05	0.1	0.02
P4A	1.0	0.27	19	0.10–0.26	1.0	0.19
P4B	1.0	0.27	12	0.05–0.18	0.6	0.11
P4C	1.0	0.24	2	0.00–0.05	0.1	0.02
P5	1.0	0.23	3	0.00–0.07	0.1	0.02
A2	0.0	0.00	14	0.06–0.21	0.8	0.15
A3A	0.0	0.00	11	0.04–0.17	0.6	0.11
A3B	0.0	0.00	10	0.03–0.16	0.5	0.09
A3C	0.0	0.00	8	0.02–0.13	0.4	0.07

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-2. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for northern flicker in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised HABCAP Coeff.	Expected Proportion[1]	Number Observed N=114	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.7	0.13	14	0.06–0.19	0.7	0.13
P3B	0.5	0.09	10	0.03–0.14	0.5	0.09
P3C	0.1	0.02	2	0.00–0.05	0.1	0.02
P4A	1.0	0.19	21	0.11–0.26	1.0	0.19
P4B	0.6	0.11	14	0.06–0.15	0.6	0.11
P4C	0.1	0.02	2	0.00–0.05	0.1	0.02
P5	0.1	0.02	6	0.01–0.10	0.1	0.02
A2	0.8	0.15	14	0.06–0.19	0.8	0.15
A3A	0.6	0.11	12	0.04–0.17	0.6	0.11
A3B	0.5	0.09	11	0.04–0.16	0.5	0.09
A3C	0.4	0.07	8	0.02–0.12	0.4	0.07

[1] *Calculated using revised HABCAP model coefficients times total number observed from 1992–94.*
[2] *HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the revised.*

Table A-3. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for red-naped sapsucker in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=109	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.2	0.04	0	0.00–0.00	0.0	0.00
P3B	0.2	0.04	0	0.00–0.00	0.0	0.00
P3C	0.2	0.04	0	0.00–0.00	0.0	0.00
P4A	0.2	0.04	2	0.00–0.05	0.1	0.04
P4B	0.5	0.10	1	0.00–0.03	0.0	<0.01
P4C	0.5	0.09	10	0.03–0.15	0.3	0.10
P5	0.5	0.08	3	0.00–0.06	0.1	0.03
A2	0.0	0.00	18	0.09–0.24	0.4	0.15
A3A	1.0	0.19	11	0.04–0.16	0.3	0.11
A3B	1.0	0.19	43	0.30–0.49	1.0	0.36
A3C	1.0	0.19	21	0.11–0.27	0.6	0.22

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-4. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for red-naped sapsucker in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=122	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.0	0.00	1	0.00–0.03	0.0	0.00
P3B	0.0	0.00	0	0.00–0.00	0.0	0.00
P3C	0.0	0.00	0	0.00–0.00	0.0	0.00
P4A	0.1	0.04	2	0.00–0.04	0.1	0.04
P4B	0.0	0.00	1	0.00–0.03	0.0	0.00
P4C	0.3	0.10	12	0.04–0.15	0.3	0.10
P5	0.1	0.03	4	0.00–0.07	0.1	0.03
A2	0.4	0.15	18	0.08–0.21	0.4	0.15
A3A	0.3	0.11	16	0.06–0.19	0.3	0.11
A3B	1.0	0.36	46	0.28–0.45	1.0	0.36
A3C	0.6	0.22	26	0.13–0.28	0.6	0.22

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the revised.*

Table A-5. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for hairy woodpecker in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=193	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	1.0	0.14	33	0.12–0.22	1.0	0.16
P3B	1.0	0.14	21	0.07–0.16	0.7	0.11
P3C	1.0	0.14	9	0.01–0.08	0.3	0.05
P4A	1.0	0.14	20	0.06–0.15	0.7	0.11
P4B	1.0	0.14	16	0.04–0.12	0.5	0.08
P4C	1.0	0.12	11	0.02–0.09	0.4	0.06
P5	1.0	0.12	22	0.07–0.16	0.7	0.09
A2	0.0	0.00	11	0.02–0.09	0.4	0.06
A3A	0.2	0.03	11	0.02–0.09	0.4	0.06
A3B	0.2	0.03	19	0.05–0.14	0.7	0.11
A3C	0.2	0.03	20	0.06–0.15	0.7	0.11

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-6. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for hairy woodpecker in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=247	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	1.0	0.16	40	0.11–0.21	1.0	0.16
P3B	0.7	0.11	29	0.08–0.16	0.7	0.11
P3C	0.3	0.05	14	0.03–0.09	0.3	0.05
P4A	0.7	0.11	33	0.09–0.18	0.7	0.11
P4B	0.5	0.08	16	0.03–0.10	0.5	0.08
P4C	0.4	0.06	16	0.03–0.10	0.4	0.06
P5	0.7	0.10	30	0.08–0.16	0.7	0.10
A2	0.4	0.06	11	0.02–0.07	0.4	0.06
A3A	0.4	0.06	12	0.02–0.08	0.4	0.06
A3B	0.7	0.11	26	0.06–0.15	0.7	0.11
A3C	0.7	0.11	20	0.04–0.12	0.7	0.11

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the revised.*

Table A-7. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for dusky flycatcher in 4 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=408	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
A2	1.0	0.29	137	0.29–0.38	1.0	0.33
A3A	0.8	0.24	105	0.21–0.30	0.8	0.27
A3B	0.9	0.26	82	0.16–0.24	0.6	0.20
A3C	0.7	0.21	84	0.17–0.25	0.6	0.20

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-8. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for gray jay in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=129	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.1	0.03	2	0.00–0.04	0.1	0.03
P3B	0.2	0.07	9	0.02–0.12	0.2	0.06
P3C	0.2	0.07	8	0.02–0.11	0.2	0.06
P4A	0.3	0.10	20	0.09–0.22	0.5	0.16
P4B	1.0	0.34	39	0.22–0.39	1.0	0.31
P4C	0.9	0.28	40	0.23–0.39	1.0	0.29
P5	0.3	0.09	6	0.01–0.09	0.2	0.06
A2	0.0	0.00	0	0.00–0.00	0.0	0.00
A3A	0.0	0.00	0	0.00–0.00	0.0	0.00
A3B	0.0	0.00	4	0.01–0.06	0.1	0.03
A3C	0.0	0.00	1	<0.01–0.03	0.0	<0.01

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-9. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for black-capped chickadee in 12 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=1101	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.5	0.06	76	0.05–0.08	0.5	0.06
P3B	0.9	0.10	117	0.09–0.12	0.9	0.10
P3C	0.8	0.09	110	0.08–0.12	0.8	0.09
P4A	0.8	0.09	95	0.07–0.10	0.8	0.09
P4B	0.9	0.10	107	0.08–0.12	0.9	0.10
P4C	0.7	0.07	91	0.07–0.10	0.7	0.07
P5	0.9	0.09	116	0.09–0.12	0.9	0.09
A2	0.8	0.09	86	0.06–0.09	0.8	0.09
A3A	0.7	0.08	84	0.06–0.09	0.7	0.08
A3B	1.0	0.11	114	0.09–0.12	1.0	0.11
A3C	0.8	0.09	94	0.07–0.10	0.8	0.09
WM	0.1	0.01	11	0.00–0.02	0.1	0.01

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the new.*

Table A-10. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for white-breasted nuthatch in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=203	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.0	0.00	11	0.02–0.09	0.1	0.04
P3B	0.0	0.00	40	0.14–0.25	0.5	0.21
P3C	0.0	0.00	26	0.08–0.18	0.3	0.13
P4A	0.5	0.31	20	0.06–0.14	0.3	0.13
P4B	0.5	0.31	32	0.10–0.21	0.4	0.17
P4C	0.2	0.11	19	0.05–0.14	0.2	0.08
P5	0.5	0.27	10	0.02–0.08	0.1	0.04
A2	0.0	0.00	2	0.00–0.03	0.0	<0.01
A3A	0.0	0.00	6	0.01–0.06	0.1	0.04
A3B	0.0	0.00	18	0.05–0.13	0.2	0.08
A3C	0.0	0.00	19	0.05–0.14	0.2	0.08

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-11. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for white-breasted nuthatch in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=258	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.1	0.04	16	0.03–0.09	0.2	0.08
P3B	0.5	0.21	45	0.13–0.22	0.5	0.19
P3C	0.3	0.13	31	0.08–0.16	0.3	0.11
P4A	0.3	0.13	24	0.06–0.13	0.2	0.08
P4B	0.4	0.17	39	0.11–0.20	0.4	0.15
P4C	0.2	0.08	28	0.07–0.15	0.3	0.10
P5	0.1	0.04	25	0.06–0.14	0.3	0.10
A2	0.0	0.00	3	0.00–0.03	0.0	<0.01
A3A	0.1	0.04	8	0.01–0.05	0.1	0.04
A3B	0.2	0.08	18	0.04–0.10	0.2	0.08
A3C	0.2	0.08	21	0.05–0.12	0.2	0.08

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-12. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for red-breasted nuthatch in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=652	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.2	0.05	47	0.05–0.09	0.5	0.08
P3B	0.2	0.05	63	0.07–0.12	0.6	0.09
P3C	0.2	0.05	96	0.12–0.18	1.0	0.15
P4A	1.0	0.23	40	0.04–0.08	0.4	0.06
P4B	1.0	0.23	95	0.12–0.17	1.0	0.15
P4C	1.0	0.21	85	0.10–0.16	1.0	0.14
P5	1.0	0.20	102	0.13–0.19	1.0	0.13
A2	0.0	0.00	11	0.01–0.03	0.1	0.02
A3A	0.0	0.00	22	0.02–0.05	0.2	0.03
A3B	0.0	0.00	34	0.03–0.07	0.3	0.05
A3C	0.0	0.00	57	0.07–0.11	0.6	0.09

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-13. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for red-breasted nuthatch in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=894	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.5	0.08	73	0.06–0.10	0.5	0.09
P3B	0.6	0.09	87	0.08–0.12	0.5	0.09
P3C	1.0	0.15	128	0.12–0.17	0.8	0.15
P4A	0.4	0.06	52	0.04–0.07	0.3	0.06
P4B	1.0	0.15	130	0.12–0.17	0.8	0.15
P4C	1.0	0.14	127	0.12–0.16	0.8	0.14
P5	1.0	0.13	160	0.15–0.20	1.0	0.17
A2	0.1	0.02	11	<0.01–0.02	0.1	0.02
A3A	0.2	0.03	22	0.01–0.04	0.1	0.02
A3B	0.3	0.05	37	0.03–0.05	0.2	0.04
A3C	0.6	0.09	71	0.06–0.10	0.4	0.07

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-14. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for ruby-crowned kinglet in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=141	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.2	0.04	0	0.00–0.00	0.0	0.00
P3B	0.2	0.04	0	0.00–0.00	0.0	0.00
P3C	0.2	0.04	0	0.00–0.00	0.0	0.00
P4A	0.5	0.09	4	0.00–0.06	0.2	0.05
P4B	1.0	0.18	11	0.03–0.13	0.4	0.09
P4C	1.0	0.16	26	0.12–0.25	0.9	0.19
P5	1.0	0.15	31	0.15–0.29	1.0	0.20
A2	0.2	0.04	12	0.04–0.13	0.4	0.09
A3A	0.5	0.09	10	0.02–0.12	0.3	0.07
A3B	0.5	0.09	23	0.10–0.23	0.7	0.16
A3C	0.5	0.09	24	0.10–0.24	0.7	0.16

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-15. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for ruby-crowned kinglet in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=154	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.0	0.00	0	0.00–0.00	0.0	0.00
P3B	0.0	0.00	0	0.00–0.00	0.0	0.00
P3C	0.0	0.00	0	0.00–0.00	0.0	0.00
P4A	0.2	0.05	5	0.00–0.06	0.2	0.05
P4B	0.4	0.09	13	0.04–0.13	0.4	0.09
P4C	0.9	0.19	28	0.12–0.25	0.9	0.19
P5	1.0	0.20	35	0.16–0.30	1.0	0.20
A2	0.4	0.09	15	0.05–0.15	0.4	0.09
A3A	0.3	0.07	10	0.02–0.11	0.3	0.07
A3B	0.7	0.16	23	0.09–0.21	0.7	0.16
A3C	0.7	0.16	25	0.10–0.22	0.7	0.16

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the revised.*

Table A-16. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for mountain bluebird in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=101	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.0	0.00	30	0.20–0.39	1.0	0.30
P3B	0.0	0.00	0	0.00–0.00	0.0	0.00
P3C	0.0	0.00	1	0.00–0.03	0.0	<0.01
P4A	1.0	0.47	21	0.12–0.29	0.7	0.21
P4B	0.5	0.24	1	0.00–0.03	0.0	<0.01
P4C	0.2	0.09	3	0.00–0.07	0.1	0.03
P5	0.5	0.20	0	0.00–0.00	0.0	0.00
A2	0.0	0.00	19	0.11–0.17	0.6	0.18
A3A	0.0	0.00	18	0.10–0.26	0.6	0.18
A3B	0.0	0.00	8	0.02–0.14	0.3	0.09
A3C	0.0	0.00	0	0.00–0.00	0.0	0.00

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-17. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for mountain bluebird in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=141	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	1.0	0.30	41	0.21–0.37	1.0	0.30
P3B	0.0	0.00	2	0.00–0.04	0.0	0.00
P3C	0.0	0.00	1	0.00–0.02	0.0	0.00
P4A	0.7	0.21	35	0.17–0.32	0.7	0.21
P4B	0.0	0.00	1	0.00–0.02	0.0	0.00
P4C	0.1	0.03	5	0.00–0.07	0.1	0.03
P5	0.0	0.00	0	0.00–0.00	0.0	0.00
A2	0.6	0.18	22	0.09–0.22	0.6	0.18
A3A	0.6	0.18	26	0.12–0.25	0.6	0.18
A3B	0.3	0.09	8	0.01–0.10	0.3	0.09
A3C	0.0	0.00	0	0.00–0.00	0.0	0.00

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*

[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the revised.*

Table A-18. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for Townsend's solitaire in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=400	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.8	0.16	61	0.12–0.19	0.8	0.15
P3B	0.8	0.16	69	0.13–0.21	0.9	0.17
P3C	1.0	0.19	81	0.16–0.24	1.0	0.19
P4A	0.7	0.14	40	0.07–0.13	0.5	0.10
P4B	0.7	0.14	54	0.10–0.17	0.7	0.13
P4C	0.5	0.09	39	0.07–0.13	0.5	0.09
P5	0.2	0.03	28	0.04–0.10	0.4	0.07
A2	0.1	0.02	7	0.00–0.03	0.1	0.02
A3A	0.1	0.02	4	0.00–0.02	0.1	0.02
A3B	0.2	0.04	13	0.01–0.05	0.2	0.04
A3C	0.1	0.02	4	0.00–0.02	0.1	0.02

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*

[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-19. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for American robin in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=383	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.2	0.06	44	0.08–0.15	0.6	0.12
P3B	0.3	0.09	29	0.05–0.10	0.4	0.08
P3C	0.2	0.06	17	0.02–0.07	0.2	0.04
P4A	0.3	0.09	41	0.07–0.14	0.5	0.10
P4B	0.1	0.03	23	0.04–0.09	0.3	0.06
P4C	0.1	0.03	13	0.01–0.05	0.2	0.04
P5	0.1	0.23	14	0.02–0.06	0.2	0.04
A2	0.2	0.06	21	0.03–0.08	0.3	0.06
A3A	0.5	0.15	66	0.13–0.21	0.9	0.18
A3B	1.0	0.30	78	0.16–0.25	1.0	0.20
A3C	0.4	0.12	37	0.07–0.13	0.5	0.10

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-20. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for warbling vireo in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=690	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.2	0.08	16	0.01–0.04	0.0	0.01
P3B	0.2	0.08	10	0.01–0.02	0.0	0.01
P3C	0.0	0.00	9	0.01–0.02	0.0	0.01
P4A	0.2	0.08	14	0.01–0.03	0.0	0.02
P4B	0.0	0.00	14	0.01–0.03	0.0	0.01
P4C	0.0	0.00	10	0.01–0.02	0.0	0.01
P5	0.0	0.00	22	0.02–0.05	0.1	0.04
A2	0.5	0.19	133	0.17–0.22	0.4	0.20
A3A	0.5	0.19	150	0.19–0.25	0.5	0.25
A3B	0.5	0.19	144	0.18–0.24	0.5	0.25
A3C	0.5	0.19	168	0.21–0.28	0.5	0.25

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-21. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for warbling vireo in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=939	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.0	0.00	17	0.01–0.03	0.0	0.02
P3B	0.0	0.00	13	0.01–0.02	0.0	0.01
P3C	0.0	0.00	9	0.01–0.02	0.0	0.01
P4A	0.0	0.00	14	0.01–0.02	0.0	0.02
P4B	0.0	0.00	14	0.01–0.02	0.0	0.02
P4C	0.0	0.00	11	0.01–0.02	0.0	0.01
P5	0.1	0.05	28	0.02–0.04	0.0	0.03
A2	0.4	0.20	196	0.18–0.24	0.4	0.22
A3A	0.5	0.25	209	0.20–0.25	0.5	0.28
A3B	0.5	0.25	193	0.18–0.23	0.4	0.22
A3C	0.5	0.25	235	0.22–0.28	0.5	0.28

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-22. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for yellow-rumped warbler in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=1064	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.6	0.09	103	0.08–0.12	0.6	0.09
P3B	1.0	0.15	160	0.13–0.17	1.0	0.15
P3C	0.9	0.14	137	0.11–0.15	0.9	0.14
P4A	0.7	0.11	106	0.08–0.12	0.7	0.11
P4B	1.0	0.15	159	0.13–0.17	1.0	0.15
P4C	0.9	0.13	149	0.12–0.16	0.9	0.13
P5	0.6	0.08	131	0.10–0.14	0.8	0.11
A2	0.1	0.02	16	0.01–0.02	0.1	0.02
A3A	0.2	0.03	20	0.01–0.03	0.1	0.02
A3B	0.4	0.06	44	0.03–0.05	0.3	0.05
A3C	0.3	0.05	39	0.03–0.05	0.3	0.05

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-23. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for MacGillivray's warbler in 4 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=45	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
A2	1.0	0.37	10	0.09–0.36	0.5	0.23
A3A	1.0	0.37	20	0.29–0.60	1.0	0.45
A3B	0.5	0.19	13	0.14–0.43	0.5	0.23
A3C	0.2	0.07	2	0.00–0.12	0.2	0.09

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-24. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for MacGillivray's warbler in 4 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=54	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
A2	0.5	0.23	10	0.07–0.30	0.5	0.23
A3A	1.0	0.45	29	0.39–0.68	1.0	0.45
A3B	0.5	0.23	13	0.12–0.37	0.5	0.23
A3C	0.2	0.09	2	0.00–0.10	0.2	0.09

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the revised.*

Table A-25. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for ovenbird in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=376	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.2	0.05	8	0.01–0.04	0.0	<0.01
P3B	0.2	0.05	18	0.03–0.07	0.1	0.06
P3C	0.2	0.05	15	0.02–0.06	0.1	0.06
P4A	0.5	0.13	8	0.01–0.04	0.0	<0.01
P4B	0.5	0.13	9	0.01–0.04	0.0	0.01
P4C	0.2	0.05	14	0.02–0.06	0.1	0.05
P5	0.5	0.12	98	0.21–0.31	0.5	0.24
A2	0.0	0.00	14	0.02–0.06	0.1	0.06
A3A	0.5	0.13	14	0.02–0.06	0.1	0.06
A3B	0.5	0.13	63	0.13–0.21	0.3	0.17
A3C	0.5	0.13	115	0.26–0.35	0.5	0.28

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-26. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for ovenbird in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=486	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.0	0.00	8	0.00–0.03	0.0	0.01
P3B	0.1	0.06	18	0.02–0.05	0.0	0.03
P3C	0.1	0.06	15	0.01–0.05	0.0	0.02
P4A	0.0	0.00	8	0.00–0.03	0.0	0.01
P4B	0.0	0.00	12	0.01–0.04	0.0	0.02
P4C	0.1	0.05	18	0.02–0.05	0.0	0.02
P5	0.5	0.25	109	0.19–0.26	0.4	0.24
A2	0.1	0.06	20	0.02–0.06	0.0	0.03
A3A	0.1	0.06	30	0.04–0.08	0.1	0.07
A3B	0.3	0.17	84	0.14–0.21	0.3	0.21
A3C	0.5	<0.29	164	0.29–0.38	0.5	0.34

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-27. Chi-square evaluation of existing HABCAP model coefficients and proposed revisions to HABCAP coefficients for vesper sparrow in 5 forest structural stages in the Black Hills.

Structural Stage Acronymn	HABCAP Model Coeff.	Expected Proportion[1]	Number Observed N=62	CI for Observed Proportion	Revised HABCAP Coeff.[2]	Revised Expected Proportion
P3A	0.0	0.00	6	0.02–0.18	0.2	0.16
P4A	0.0	0.00	6	0.02–0.18	0.2	0.16
A2	1.0	0.39	8	0.04–0.22	0.2	0.16
WM	1.0	0.39	4	0.00–0.13	0.1	0.08
DM	1.0	0.22	38	0.48–0.74	1.0	0.45

[1] *Calculated using existing HABCAP model coefficients multiplied times total number observed in 1992–1993.*
[2] *Revised HABCAP coefficients were rounded to the nearest tenth.*

Table A-28. Chi-square evaluation of revised HABCAP model coefficients and proposed final HABCAP coefficients for vesper sparrow in 5 forest structural stages in the Black Hills.

Structural Stage Acronymn	Revised Model Coeff.	Expected Proportion[1]	Number Observed N=87	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.2	0.16	6	0.01–0.13	0.1	0.10
P4A	0.2	0.16	6	0.01–0.13	0.1	0.10
A2	0.2	0.16	8	0.03–0.16	0.1	0.10
WM	0.1	0.08	4	0.00–0.10	0.1	0.10
DM	1.0	0.45	63	0.62–0.82	1.0	0.59

[1] *Calculated using revised HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-29. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for chipping sparrow in 12 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=546	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.7	0.11	104	0.16–0.22	1.0	0.19
P3B	0.2	0.03	13	0.01–0.04	0.1	0.02
P3C	0.3	0.05	22	0.02–0.06	0.2	0.04
P4A	0.8	0.13	52	0.07–0.12	0.5	0.09
P4B	0.2	0.03	21	0.02–0.06	0.2	0.04
P4C	0.1	0.01	6	0.00–0.02	0.1	0.02
P5	0.3	0.04	25	0.03–0.06	0.3	0.05
A2	0.9	0.14	74	0.11–0.17	0.7	0.13
A3A	1.0	0.16	78	0.11–0.17	0.8	0.15
A3B	0.7	0.11	53	0.07–0.12	0.5	0.09
A3C	0.2	0.03	20	0.02–0.05	0.2	0.04
WM	1.0	0.16	78	0.11–0.17	0.8	0.15

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

Table A-30. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for dark-eyed junco in 12 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=1613	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.9	0.13	229	0.12–0.16	0.9	0.13
P3B	0.6	0.09	127	0.07–0.09	0.6	0.09
P3C	0.2	0.03	50	0.02–0.04	0.2	0.03
P4A	1.0	0.15	226	0.12–0.16	1.0	0.15
P4B	0.5	0.07	126	0.06–0.09	0.5	0.07
P4C	0.4	0.05	88	0.04–0.07	0.4	0.05
P5	0.4	0.05	81	0.04–0.06	0.4	0.05
A2	1.0	0.14	228	0.12–0.16	1.0	0.14
A3A	0.7	0.10	154	0.08–0.11	0.7	0.10
A3B	0.6	0.09	134	0.07–0.09	0.6	0.09
A3C	0.5	0.07	112	0.06–0.08	0.5	0.07
WM	0.2	0.03	58	0.03–0.05	0.2	0.03

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth. Observed abundance did not differ from predicted, so final coefficients are the same as the new.*

Table A-31. Chi-square evaluation of new HABCAP model coefficients and proposed final HABCAP coefficients for western tanager in 11 forest structural stages in the Black Hills.

Structural Stage Acronymn	New Model Coeff.	Expected Proportion[1]	Number Observed N=287	CI for Observed Proportion	Final HABCAP Coeff.[2]	Final Expected Proportion
P3A	0.2	0.06	26	0.06–0.13	0.3	0.09
P3B	0.4	0.13	49	0.13–0.22	0.6	0.18
P3C	0.2	0.06	15	0.02–0.08	0.2	0.06
P4A	0.4	0.13	41	0.10–0.19	0.5	0.15
P4B	0.3	0.10	27	0.06–0.13	0.3	0.09
P4C	0.2	0.06	17	0.03–0.09	0.2	0.05
P5	1.0	0.29	72	0.20–0.30	1.0	0.26
A2	0.1	0.03	2	0.00–0.02	0.0	<0.01
A3A	0.1	0.03	11	0.01–0.06	0.1	0.03
A3B	0.1	0.03	9	0.01–0.05	0.1	0.03
A3C	0.2	0.06	18	0.03–0.09	0.2	0.06

[1] *Calculated using new HABCAP model coefficients multiplied times total number observed in 1992–1994.*
[2] *Final HABCAP coefficients were rounded to the nearest tenth.*

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